Combination Dry and Absorbent Flo r Mop/Wip

Fi ld of the Invention

The present invention relates to a cleaning sheet having a first side which captures and holds dust, dirt debris and other particles and a second side which is capable of absorbing fluids.

Background of the Invention

Currently, commercially available cleaning sheets are of one of three types. These types of cleaning sheets include wet cleaning sheets, dry cleaning sheets and absorbent cleaning sheets. Wet cleaning sheets typically contain a cleaning fluid and are preferably saturated with the cleaning fluid. As a surface is cleaned with the wet cleaning sheet, the cleaning solution is released from the cleaning sheet to solubilize any dirt on the surface to be cleaned so that the wet cleaning sheet can pick-up and retain the dirt. By contrast, a dry cleaning sheet does not contain any cleaning fluid. Instead, a dry cleaning sheet is one that has a structure which attracts or retains dirt, dust, debris and other particles. In this first type of a dry cleaning sheet, no fluids are necessary to clean the surface to be cleaned. The absorbent cleaning sheet absorbs and retains liquids applied from a separate source, such as spray cans, to the surface to be cleaned. The absorbent cleaning sheet is dry until used to absorb and retain liquids.

Many different dry cleaning sheets are known in the art. For example, U.S. Patent 6,245,413 discloses a dry cleaning sheet which attracts dust and retains dust within the structure of the cleaning sheet. While these cleaning sheets attract and retain larger particles from a surface being cleaned, they do not effectively remove dirt physically attached to the surface to be cleaned. Commercially available dry cleaning sheets of the first type are available from S.C. Johnson and Sons, Racine, Wisconsin, under the tradename Grab-It ™ Dry Cloths and from The Procter and Gamble Company, Cincinnati, Ohio, under the name Swiffer ™ Dry.

The absorbent cleaning sheet is designed to absorb liquids. For example U.S. Patents 5,960,508 and 6,101,661 each disclose a cleaning sheet which exhibits a controlled rate of fluid absorbency to reduce the amount of cleaning fluid needed to clean a surface. Current commercially available absorbent cleaning sheets and cleaning implements include the Swiffer ™ Wet Jet, available from The Procter and Gamble Company, Cincinnati, Ohio, and the Grab-It ™ Go Mop, available from S.C. Johnson and Sons, Racine, Wisconsin.

Currently, a user desiring to clean a surface with both the attractive dry cleaning sheet and the absorbent dry cleaning sheet would have to have both dry cleaning sheets and absorbent cleaning sheets readily available. However, having both types of sheets available for cleaning requires additional storage space, the need to ensure that both sheets are available at the time of cleaning and the need to have a mop or cleaning implement which is able to retain both types of sheets during use. There is not a cleaning sheet available on the market which allows the user to effectively clean a surface using both dry attractive cleaning and absorptive cleaning. Therefore, there is a need in the art for a cleaning sheets which allows a user to dry clean a surface and to absorb a cleaning fluid using a single cleaning sheet.

Summary of the Invention

The present invention provides a single cleaning sheet which allows a user to dry clean a surface with a cleaning sheet that attracts dust, dirt, debris and other particles, while providing absorbency to absorb any cleaning fluid used in a subsequent cleaning operation, in particular for stains and other dirt or debris which is not attracted to the cleaning sheet. The cleaning sheet of the present invention has a first surface and a second surface, the first surface is on an opposite side of the cleaning sheet from the second surface, wherein the first surface has the ability to attract and retain dirt, dust, debris and other particles and the second surface has the ability to absorb fluids.

Brief Description of the Drawings

Figure 1 shows a cross-section of an exemplary cleaning sheet of the present invention.

Figure 2 shows a cross-section of another exemplary cleaning sheet of the present invention.

Figure 3 shows a cross-section of an exemplary cleaning sheet of the present invention, with a barrier layer between the two surfaces.

Figure 4 illustrates a cleaning implement of the present invention.

Definitions

As used herein, the term "comprising" is inclusive or open-ended and does not exclude additional unrecited elements, compositional components, or method steps.

As used herein, the term "consisting essentially of" does not exclude the presence of additional materials which do not significantly affect the desired characteristics of a given composition or product. Exemplary materials of this sort would include, without limitation, pigments, antioxidants, stabilizers, surfactants, waxes, flow promoters, particulates and materials added to enhance processability of the composition.

As used herein, the term "polymer" generally includes but is not limited to, homopolymers, copolymers, such as for example, block, graft, random and alternating copolymers, terpolymers, etc. and blends and modifications thereof. Furthermore, unless otherwise specifically limited, the term "polymer" shall include all possible geometrical configurations of the material. These configurations include, but are not limited to isotactic, syndiotactic and random symmetries.

As used herein, the term "fiber" includes both staple fibers, i.e., fibers which have a defined length between about 19 mm and about 60 mm, fibers longer than staple fiber but are not continuous, and continuous fibers, which are sometimes called "substantially continuous filaments" or simply "filaments". The method in which the fiber is prepared will determine if the fiber is a staple fiber or a continuous filament.

As used herein the term "monocomponent" fiber refers to a fiber formed from one or more extruders using only one polymer. This is not meant to exclude fibers formed from one polymer to which small amounts of additives have been added for color, anti-static properties, lubrication, hydrophilicity, etc. These additives, e.g. titanium dioxide for color, are generally present in an amount less than 5 weight percent and more typically about 2 weight percent.

As used herein the term "multicomponent fibers" refers to fibers which have been formed from at least two component polymers, or the same polymer with different properties or additives, extruded from separate extruders but spun together to form one fiber. Multicomponent fibers are also sometimes referred to as conjugate fibers or bicomponent fibers. The polymers are arranged in substantially constantly positioned distinct zones across the cross-section of the multicomponent fibers and extend continuously along the length of the multicomponent fibers. The configuration of such a multicomponent fiber may be, for example, a sheath/core arrangement wherein one polymer is surrounded by another, or may be a side by side arrangement, an "islands-in-the-sea" arrangement, or arranged as pie-wedge shapes or as stripes on a round, oval, or rectangular cross-section fiber. Multicomponent fibers are taught in, for example, U.S. Pat. No. 5,108,820 to Kaneko et al., U.S. Pat. No. 5,336,552 to Strack

et al., and U.S. Pat. No. 5,382,400 to Pike et al. For two component fibers, the polymers may be present in ratios of 75/25, 50/50, 25/75 or any other desired ratios.

As used herein the term "biconstituent fiber" or "multiconstituent fiber" refers to a fiber formed from at least two polymers, or the same polymer with different properties or additives, extruded from the same extruder as a blend and wherein the polymers are not arranged in substantially constantly positioned distinct zones across the cross-section of the multicomponent fibers. Fibers of this general type are discussed in, for example, U.S. Pat. No. 5,108,827 to Gessner.

As used herein the term "nonwoven web" or "nonwoven material" means a web having a structure of individual fibers or filaments which are interlaid, but not in an identifiable manner as in a knitted or woven fabric. Nonwoven webs have been formed from many processes such as for example, meltblowing processes, spunbonding processes, air-laying processes and carded web processes. The basis weight of nonwoven fabrics is usually expressed in grams per square meter (gsm) or ounces of material per square yard (osy) and the fiber diameters useful are usually expressed in microns. (Note that to convert from osy to gsm, multiply osy by 33.91).

As used herein, the term "meltblowing" or "meltblown" refers to fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, die capillaries as molten threads or filaments into converging high velocity heated gas (e.g., air) streams which attenuate the filaments of molten thermoplastic material to reduce their diameters. Thereafter, the meltblown fibers are carried by the high velocity gas stream and are deposited on a collecting surface to form a web of randomly dispersed meltblown fibers. Such a process is disclosed, for example, in U.S. Pat. No. 3,849,241 to Butin, which is hereby incorporated by reference in its entirety. Meltblowing processes can be used to make fibers of various dimensions, including macrofibers (with average diameters from about 40 to about 100 microns), textile-type fibers (with average diameters between about 10 and about 40 microns), and microfibers (with average diameters less than about 10 microns). Meltblowing processes are particularly suited to making microfibers, including ultra-fine microfibers (with average diameters of about 3 microns or less). Meltblown fibers may be continuous or discontinuous, and are generally self bonding when deposited onto a collecting surface.

As used herein, the term "spunbond web" or "spunbond" refers to a nonwoven web prepared from small diameter fibers of molecularly oriented polymeric material. Spunbond fibers may be formed by extruding molten thermoplastic material as filaments from a plurality of fine, usually circular capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced as in, for example, U.S.

Patent No. 4,340,563 to Appel et al., and U.S. Patent No. 3,692,618 to Dorschner et al., U.S. Patent No. 3,802,817 to Matsuki et al., U.S. Patent Nos. 3,338,992 and 3,341,394 to Kinney, U.S. Patent No. 3,502,763 to Hartman, U.S. Patent No. 3,542,615 to Dobo et al, and U.S. Patent No. 5,382,400 to Pike et al. Spunbond fibers are generally not tacky when they are deposited onto a collecting surface and are generally continuous. Spunbond fibers are often about 10 microns or greater in diameter. However, fine fiber spunbond webs (having an average fiber diameter less than about 10 microns) may be achieved by various methods including, but not limited to, those described in commonly assigned U.S. Patent No. 6,200,669 to Marmon et al. and U.S. Pat. No. 5,759,926 to Pike et al., each is hereby incorporated by reference in its entirety.

As used herein, the phrase "bonded carded web" or "bcw" refers to webs that are made from staple fibers which are sent through a combing or carding unit, which separates or breaks apart and aligns the staple fibers in the machine direction to form a generally machine direction-oriented fibrous nonwoven web. Such fibers are usually purchased in bales which are placed in an opener/blender or picker which separates the fibers prior to the carding unit. Once the web is formed, it then is bonded by one or more of several known bonding methods. One such bonding method is powder bonding, wherein a powdered adhesive is distributed through the web and then activated, usually by heating the web and adhesive with hot air. Another suitable bonding method is pattern bonding, wherein heated calender rolls or ultrasonic bonding equipment are used to bond the fibers together, usually in a localized bond pattern, though the web can be bonded across its entire surface if so desired. Another suitable and well-known bonding method, particularly when using bicomponent staple fibers, is through-air bonding.

"Airlaying" or "airlaid web" is a well known process by which a fibrous nonwoven layer can be formed. In the airlaying process, bundles of small fibers having typical lengths ranging from about 3 to about 19 millimeters (mm) are separated and entrained in an air supply and then deposited onto a forming screen, usually with the assistance of a vacuum supply. The randomly deposited fibers then are bonded to one another using, for example, hot air or a spray adhesive.

As used herein, through-air bonding or "TAB" means a process of bonding a nonwoven fiber web in which air, which is sufficiently hot to melt one of the polymers of which the fibers of the web are made, is forced through the web. The air velocity is between 100 and 500 feet per minute and the dwell time may be as long as 10 seconds. The melting and resolidification of the polymer provides the bonding. Through-air bonding has relatively restricted variability and since through-air bonding

requires the melting of at least one component to accomplish bonding, it is generally restricted to webs with two components like multicomponent fibers or those which include an adhesive. In the through-air bonder, air having a temperature above the melting temperature of one component and below the melting temperature of another component is directed from a surrounding hood, through the web, and into a perforated roller supporting the web. Alternatively, the through-air bonder may be a flat arrangement wherein the air is directed vertically downward onto the web. The operating conditions of the two configurations are similar, the primary difference being the geometry of the web during bonding. The hot air melts the lower melting polymer component and thereby forms bonds between the filaments to integrate the web.

As used herein, “thermal point bonding” involves passing a fabric or web of fibers or other sheet layer material to be bonded between a heated calender roll and an anvil roll. The calender roll is usually, though not always, patterned on its surface in some way so that the entire fabric is not bonded across its entire surface. As a result, various patterns for calender rolls have been developed for functional as well as aesthetic reasons. One example of a pattern has points and is the Hansen Pennings or “H&P” pattern with about a 30% bond area with about 200 bonds/square inch as taught in U.S. Pat. No. 3,855,046 to Hansen and Pennings. The H&P pattern has square point or pin bonding areas wherein each pin has a side dimension of 0.038 inches (0.965 mm), a spacing of 0.070 inches (1.778 mm) between pins, and a depth of bonding of 0.023 inches (0.584 mm). The resulting pattern has a bonded area of about 29.5%. Another typical point bonding pattern is the expanded Hansen and Pennings or “EHP” bond pattern which produces a 15% bond area with a square pin having a side dimension of 0.037 inches (0.94 mm), a pin spacing of 0.097 inches (2.464 mm) and a depth of 0.039 inches (0.991 mm). Other common patterns include a diamond pattern with repeating and slightly offset diamonds and a wire weave pattern looking as the name suggests, e.g. like a window screen. Typically, the percent bonding area varies from around 10% to around 30% of the area of the fabric laminate web. Thermal point bonding imparts integrity to individual layers by bonding fibers within the layer and/or for laminates of multiple layers, point bonding holds the layers together to form a cohesive laminate.

As used herein "pattern unbonded" or interchangeably "point unbonded" or "PUB", means a fabric pattern having continuous bonded areas defining a plurality of discrete unbonded areas. The fibers or filaments within the discrete unbonded areas are dimensionally stabilized by the continuous bonded areas that encircle or surround each unbonded area, such that no support or backing layer of film or

adhesive is required. The unbonded areas are specifically designed to afford spaces between fibers or filaments within the unbonded areas. A suitable process for forming the pattern-unbonded nonwoven material of this invention includes providing a nonwoven fabric or web, providing opposedly positioned first and second calender rolls and defining a nip there between, with at least one of said rolls being heated and having a bonding pattern on its outermost surface comprising a continuous pattern of land areas defining a plurality of discrete openings, apertures or holes, and passing the nonwoven fabric or web within the nip formed by said rolls. Each of the openings in said roll or rolls defined by the continuous land areas forms a discrete unbonded area in at least one surface of the nonwoven fabric or web in which the fibers or filaments of the web are substantially or completely unbonded. Stated alternatively, the continuous pattern of land areas in said roll or rolls forms a continuous pattern of bonded areas that define a plurality of discrete unbonded areas on at least one surface of said nonwoven fabric or web. The PUB pattern is further described in U.S. Patent 5,858,515 to Stokes et al, the entire contents of which are hereby incorporated by reference.

As used herein, the term "cleaning sheet" or "wiping sheet" is intended to include any web which is used to clean an article or a surface. Examples of cleaning sheets include, but are not limited to, webs of material containing a single sheet of material which is used to clean a surface by hand or a sheet of material which can be attached to a cleaning implement, such as a floor mop or a hand held cleaning tool, such as a duster.

As used herein, the term "debris" means items which typically need removal during a cleaning process. This term is intended to include, but is not limited to, hair (both human and pet), dandruff (both human and pet), food particles, e.g. crumbs from bread, cakes, cookies and the like, grass, dirt, defoliated skin, and other such items.

<u>Detailed Description of the Invention</u>

The present invention provides a single cleaning sheet which allows a user to dry clean a surface with a cleaning sheet that attracts dust, dirt and other particles, while providing absorbency to absorb any cleaning fluid used in a subsequent cleaning operation, in particular for stains and other dirt or debris which is not attracted to the dry cleaning sheet. The cleaning sheet of the present invention has a first surface and a second surface, wherein the first surface is on an opposite side of the cleaning sheet from the second surface, and the first surface is prepared from a first material which has the ability to attract and retain, dirt, dust and other debris

while the second surface is prepared from a second material having the ability to absorb fluids.

In order to gain a better understanding of the present invention, attention is directed to Figure 1. In Figure 1, a cleaning sheet 100 is shown having a first side 111, prepared from a first material 110, and a second side 121, prepared from a second material 120. The first surface 111 of the cleaning sheet 100 is prepared from a material which has a structure that will have the ability to attract and retain, dirt, dust and other debris. The second surface 121 of the cleaning sheet 100 is prepared from a second material 120 which will absorb fluids.

In another aspect of the present invention, one of both of the first and second materials may be a laminate of two or more materials. This is shown in Figure 2A, which shows a cleaning sheet 200 having a first side 211, prepared from a first material which has a structure that will have the ability to attract and retain, dirt, dust and other debris, and a second side 221, prepared from a second material 220. The second material is shown as a laminate of two materials 222 and 224. One or both of the materials may be absorbent, provided that the overall property of the second material 220 is such that the material will absorb fluids. As is shown in Figure 2A, the two layers are coextensive. However, as is shown in Figure 2B, one of the layers may be contained within another layer such that one of the layers 222 extends to an outer surface of the cleaning sheet. For example, in Figure 2B, layer 224 does not extend out to the surface of the cleaning sheet.

The first material is a material which has the ability to attract and retain, dirt, dust and other debris. Any material can be used to form this layer or surface of the cleaning sheet, including woven, knitted and nonwoven materials, provided that the material selected has the ability to attract and retain, dirt, dust and other debris. From the standpoint of cost and properties obtained, the material is desirably a nonwoven material.

Exemplary nonwoven materials, commonly called "nonwoven webs" include, nonwoven webs from monocomponent, multiconstituent, or multicomponent fibers. In addition, the shape of the fibers can be round or have a desired shape, such as multilobal fibers. Examples of nonwoven webs usable in the dry cleaning layer include, spunbond nonwoven webs, meltblown nonwoven webs, air-laid nonwoven webs and bonded carded nonwoven webs.

The nonwoven webs of the present invention can be prepared from any thermoplastic polymer. The polymers suitable for the present invention include polyolefins, polyesters, polyamides, polycarbonates, polyurethanes, polyvinylchloride, polytetrafluoroethylene, polystyrene, polyethylene terephathalate, biodegradable

polymers such as polylactic acid and copolymers and blends thereof. Suitable polyolefins include polyethylene, e.g., high density polyethylene, medium density polyethylene, low density polyethylene and linear low density polyethylene; polypropylene, e.g., isotactic polypropylene, syndiotactic polypropylene, blends of isotactic polypropylene and atactic polypropylene, and blends thereof; polybutylene, e.g., poly(1-butene) and poly(2-butene); polypentene, e.g., poly(1-pentene) and poly(2-pentene); poly(3-methyl-1-pentene); poly(4-methyl 1-pentene); and copolymers and blends thereof. Suitable copolymers include random and block copolymers prepared from two or more different unsaturated olefin monomers, such as ethylene/propylene and ethylene/butylene copolymers. Suitable polyamides include nylon 6, nylon 6/6, nylon 4/6, nylon 11, nylon 12, nylon 6/10, nylon 6/12, nylon 12/12, copolymers of caprolactam and alkylene oxide diamine, and the like, as well as blends and copolymers thereof. Suitable polyesters include polyethylene terephthalate, polytrimethylene terephthalate, polybutylene terephthalate, polytetramethylene terephthalate, polycyclohexylene-1,4-dimethylene terephthalate, and isophthalate copolymers thereof, as well as blends thereof.

Many polyolefins are available for fiber production, for example polyethylenes such as Dow Chemical's ASPUN 6811A linear low-density polyethylene, 2553 LLDPE and 25355 and 12350 high density polyethylene are such suitable polymers. The polyethylenes have melt flow rates in g/10 min. at 190° F. and a load of 2.16 kg, of about 26, 40, 25 and 12, respectively. Fiber forming polypropylenes include Exxon Chemical Company's ESCORENE PD3445 polypropylene. Many other polyolefins are commercially available and generally can be used in the present invention.

The polymers used to make the nonwoven web may contain additives, such as surfactants or slip agents, to aid in the sliding of the sensitive surface against the nonwoven material. Other additives, such as pigments, dyes, processing aids and the like can be added to the polymer prior to fiber formation, provided that the additives do not adversely affect the ability of the nonwoven web to pickup and retain dirt, dust and/or debris and/or the ability of the nonwoven web to absorb liquids. Ferroelectric materials, such as those disclosed in U.S. Patent. 6, 162,535 to Turkevich et al, assigned to the assignee of this invention, and is incorporated in its entirety by reference, may also be added to fibers. In addition, other polymeric additives, such as maleic anhydride telomers may also be added, for example to provide electret stability.

The fibers of the nonwoven webs usable in the present invention include monocomponent fibers, meaning fibers prepared from one polymer component,

multiconstituent fibers, or multicomponent fibers. The multicomponent filaments may, for example, have either of an A/B or A/B/A side-by-side configuration, or a sheath-core configuration, wherein one polymer component surrounds another polymer component.

Of these nonwoven webs, spunbond nonwoven webs have been found to effective in attracting and retaining particles. The fibers produced in the spunbond process are usually in the range of from about 5 to about 50 microns in average diameter, depending on process conditions and the desired end use for the webs to be produced from such fibers. For example, increasing the polymer molecular weight or decreasing the processing temperature results in larger diameter fibers. Changes in the quench fluid temperature and pneumatic draw pressure can also affect fiber diameter. The fibers used in the practice of this invention usually have average diameters in the range of from about 7 to about 35 microns, more particularly from about 15 to about 25 microns. Exemplary spunbond fiber webs usable in the present invention include those described in US Patent No. 5,382,400 to Pike et al., US Patent No. 5,874,460 to Keck, US Patent No. 5,460,884 to Kobylivker et al., US Patent No. 5,858,515 to Stokes et al., US Patent No. 5,707,735 to Midkiff et al., and U.S. Patent No. 6,200,669 to Marmon et al.; the entire contents of each of the aforesaid references are incorporated herein by reference.

Of these spunbond material describe, the multicomponent crimped fiber spunbond nonwoven webs of Pike et al. very effective in retaining particles within the nonwoven structure. The fibers used to produce the web of this invention are multicomponent fibers. As these multicomponent fibers are produced and cooled, the differing coefficients of expansion of the polymers can cause these fibers to bend and ultimately to crimp, somewhat akin to the action of the bimetallic strip in a conventional room thermostat. Crimped fibers are described in U.S. Pat. No. 5,382,400 wherein fibers are crimped with the same air as is used to draw them. Sufficiently warm drawing air activates the latent helical crimp of the fibers as the fibers are produced and before they are deposited on the forming wire. Crimped fibers have an advantage over uncrimped fibers in that they produce a more bulky web, thereby increasing the void spacing within the nonwoven web. Larger void spacing is a desirable characteristic for cleaning sheets, since the larger voids will allow for the pickup and retention of larger particles of dirt, dust and/or debris. Therefore, crimped fibers are somewhat more desirable than uncrimped fibers in cleaning sheets. Additionally, the degree of crimp can be controlled by controlling the temperature of the drawing air, thereby providing a mechanism for controlling the web density. Generally, a higher air temperature produces a higher number of crimps.

This allows one to change the resulting bulk density, and void size distribution of the resulting cleaning sheet by simply adjusting the temperature of the air in the fiber draw unit.

Other nonwoven webs having the ability to attract and retain particles are nonwoven webs formed from multicomponent, multilobal shaped fibers. These nonwoven webs, describe in U.S. Patent Application 10/021,637, filed December 12, 2001, by Keck et al., which is hereby incorporated by reference, also have an enhanced dirt, dust and/or debris pickup and retention within the nonwoven web structure. The multicomponent, multilobal shaped fibers have "lobes" separated by depressed regions which allow the nonwoven web to attract hold the absorbed particles in place within the nonwoven structure. Tips of the multicomponent, multilobal shaped fibers increase surface area which provides for enhance surface contact, which in turn provides for the enhanced dirt, dust and/or debris pickup of the cleaning sheet. In addition, the multilobal shape of the fibers also creates voids within the nonwoven web structure which allows for dirt, dust and/or debris retention within the nonwoven web.

These multicomponent fibers may be split, crimped and through-air bonded among many other properties and bonding options. Combining the advantages of the liquid and particle pick-up and retention of multilobal fibers with the processing advantages of multicomponent fiber results in a nonwoven web which has highly desirable properties needed in cleaning sheets. In addition, the fibers of the present invention have improved processability and can provide a myriad of different nonwoven webs having properties which can be tailored to the needs of the end user.

Preferred shapes for the multilobal fibers are those described in U.S. Pat. Nos. 5,069,970 and 5,057,368 to Largman et al., assigned to Allied Signal, Inc., hereby incorporated by reference in their entirety, which describe fibers with unconventional shapes. In addition, shaped fibers are also described in U.S. Patent Nos. 5,314,743, 5,342,336 and 5,458,963 to Meirowitz et al., hereby incorporated by reference in their entirety. In addition, the multicomponent shaped fibers as is shown in U.S. Patent 5,707,735 to Midkiff et al, which is also hereby incorporated by reference in its entirety, may also be used in the first layer of the present invention. Fibers having the shapes and configurations of the '735 patent may also be used in the present invention. Generally, the multilobal fibers of the present in invention will have between 2 and 10 lobes, but preferably have between 2 and 5 lobes.

In the present invention, the nonwoven web of the first layer will typically have a bulk density of about 0.01 to about 0.2 g/cm^3. Preferably, the cleaning sheets with have a bulk density of about 0.015 to about 0.075 g/cm^3 and ideally about 0.02 to

about 0.05 g/cm^3. In addition, the nonwoven web of the first layer of the cleaning sheets of the present invention may have basis weights ranging from about 0.25 osy (8.5 gsm) to about 25 osy (850 gsm). The actual basis weight of the nonwoven material is dependent of the final use of the cleaning sheet. It is desirable that the basis weight be in the range from about 0.5 osy (17 gsm) to about 10 osy (340 gsm), and preferably about 1.0 osy (34 gsm) to about 5 osy (170 gsm), for many applications.

To further enhance the ability of the first layer to attract and retain particles, the first layer may be subjected to an electret treatment can be carried out by a number of different techniques. One technique is described in U.S. Pat. No. 5,401,446 to Tsai et al. assigned to the University of Tennessee Research Corporation and incorporated herein by reference in its entirety. Tsai describes a process whereby a web or film is sequentially subjected to a series of electric fields such that adjacent electric fields have substantially opposite polarities with respect to each other. Thus, one side of the web or film is initially subjected to a positive charge while the other side of the web or film is initially subjected to a negative charge. Then, the first side of the web or film is subjected to a negative charge and the other side of the web or film is subjected to a positive charge. Such webs are produced with a relatively high charge density without an attendant surface static electrical charge. The process may be carried out by passing the web through a plurality of dispersed non-arcing electric fields which may be varied over a range depending on the charge desired in the web. The web may be charged at a range of about 1 kVDC/cm to about 25 kVDC/cm or more particularly about 4 kVDC/cm to about 12 kVDC/cm and still more particularly about 7 kVDC/cm to about 8 kVDC/cm.

Electret charge stability can be further enhanced by grafting polar end groups onto the polymers of the multicomponent fibers. In addition, barium titanate and other polar materials may be blended with the polymers to enhance the electret treatment. Suitable blends are described in U.S. Patent. 6,162,535 to Turkevich et al, assigned to the assignee of this invention and in PCT Publication WO 00/00267 to Myers et al.

Other methods of electret treatment are known in the art such as that described in U.S. Pat. Nos. 4,215,682 to Kubik et al, U.S. Pat. No. 4,375,718 to Wadsworth, U.S. Pat. No. 4,592,815 to Nakao and U.S. Pat. No. 4,874,659 to Ando, each hereby incorporated in its entirety by reference.

The second surface is prepared from a material which will absorb fluids. Any absorbent material may be used in this layer, including, but not limited to foams, woven, knitted and nonwoven materials.

The absorbent layer can comprise a material or combination of materials that provide good absorbency. The absorbent layer desirably has a substantially uniform thickness. Additionally, the absorbent layer is desirably thin yet provides adequate absorbent capacity. Further, the absorbent layer desirably comprises a material which is wet-resilient and maintains good absorbency after absorption of the cleaning fluid. In this regard, the absorbent layer desirably is capable of substantially retaining its shape and stiffness when wet in order to prevent bunching and/or rolling during use. The absorbent layer desirably has an absorbency (i.e. absorbent capacity) of at least about 5 g/g, and still more desirably an absorbency of at least about 15 g/g. In addition, the absorbent layer desirably has a thickness less than about 1.25 cm and still more desirably between about 0.3 cm and about 1.25 cm. Further, as indicated above, the absorbent material desirably has a length and/or width so as to allow formation of flaps having the desired dimensions.

The absorbent layer, in one aspect, may comprise a mixture or stabilized matrix of pulp and substantially continuous thermoplastic fibers and/or thermoplastic staple fibers. The absorbent layer desirably comprises a combination or mixture of thermoplastic fibers and an absorbent material structured such that the pulp or other absorbent is substantial held in place. The absorbent material can comprise coform materials although other suitable absorbent fabrics comprising a combination of thermoplastic fibers and absorbent material may likewise be used in accord with the present invention. Exemplary coform materials are disclosed in commonly assigned U.S. Patent No. 5,284,703 to Everhart et al., U.S. Patent No. 5,350,624 to Georger et al., U.S. Patent No. 4,784,892 to Maddern et al. and U.S. Patent No. 4,100,324 to Anderson et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. The term “coform material” generally refers to composite materials comprising a stabilized matrix of thermoplastic fibers and a second non-thermoplastic material. As an example, coform materials may be made by a process in which at least one meltblown die head is arranged near a chute through which pulp and/or other absorbent materials are added to the web while it is forming. Suitable absorbents include, but are not limited to, fibrous organic materials such as woody or non-woody pulp such as cotton, rayon, recycled paper, wood pulp fluff, cellulose and/or cellulosic staple fibers, and also include inorganic absorbent materials such as superabsorbent materials and/or treated polymeric staple fibers. As a particular example, the coform material desirably has a basis weight between about 20 g/m^2 and about 250 g/m^2 and desirably comprises from about 5% to about 80% by weight of thermoplastic polymer fibers with the balance being the secondary material, i.e. 20- 95 percent by weight. As a specific example, the coform material can comprise

polypropylene meltblown fibers and wood pulp. Generally, the thermoplastic fibers make-up about 30-60 % by weight of the absorbent layer and the secondary material, desirably pulp, makes-up about 70-40% by weight of the absorbent layer.

Additional absorbent materials suitable for use in forming the absorbent layer also include densified pulp products such as, for example, those described in commonly assigned US Patent 6,368,609 to Fontenot et al. and US Patent No. 5,779,860 to Hollenberg et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. In order to achieve improved wet-resiliency, the absorbent layer desirably comprises a composite structure of pulp and thermoplastic polymer fibers. As a specific example, the absorbent mat can comprise an airlaid composite that is made of pulp fibers and at least about 2% by weight bicomponent fibers. The pulp fibers are desirably mixed with the bicomponent fibers in such a way so as to produce a substantially homogeneous airlaid composite. The bicomponent fibers desirably include a first polymer component and a second polymer component wherein the first polymer component melts at a temperature lower than the melting temperature of the second polymer component. As an example, the bicomponent fibers can comprise polyethylene/polyester (sheath/core) fibers having a length less than about 1.5 inches (3.81 cm) with a denier between about 1.5 to 4. The pulp fibers can have an average fiber length of at least about 2 mm, preferably 2-3 mm, and are desirably present within the composite in the range of about 70 - 98% by weight of the composite. Various pulp fibers can be utilized including, but not limited to, thermomechanical pulp fibers, chemithermomechanical pulp fibers, chemimechanical pulp fibers, refiner mechanical pulp fibers, stone groundwood pulp fibers, peroxide mechanical pulp fibers and so forth. After forming the batt, the airlaid composite is preferably heated such that at least a portion of the first polymer component of the bicomponent fibers is melted, thereby bonding the bicomponent fibers to the pulp and bicomponent fibers when cooled. Moisture can then, optionally, added on to the composite to further facilitate bonding when the composite is subsequently subjected to calendering. The airlaid composite is desirably calendered from an initial thickness of approximately 0.50 inches to 0.75 inches (1.27 - 1.91 cm) and density of about 0.02 - 0.05 g/cc. The pulp composite can be calendered or compressed as desired to achieve an absorbent mat having the desired thickness and absorbency characteristics. The airlaid composite can be calendered before or after incorporation within the cleaning sheet. In one aspect, the pulp composite can be compressed at a pressure of about 800 to 4000 pounds per linear inch (pli) (143-715 kg/linear cm) to form a thin, calendered airlaid composite having a thickness to basis

weight ratio of $3.0x10^{-3}$ mm/1 gsm to $1.0x10^{-3}$ mm/1 gsm, a thickness of 0.025 - 0.15 cm and a density of 0.1 g/cc or higher.

Desirably, the absorbent layer is a coform material containing between 40-70% by weight pulp and 60-30% by weight of a thermoplastic polymer, desirably, polypropylene from the standpoint of cost. Another desirable absorbent layer is a two layer absorbent coform material having a layer which contacts the surface to be clean containing about 30-50% by weight pulp and 70-50% by weight thermoplastic polymer and a second layer, which does not directly contact the surface to be clean containing about 60-80 % by weight pulp and 40-20% by weight thermoplastic polymer, desirably polypropylene.

The absorbent layer described above may be used alone or in combination with another layer, as is shown in FIG 2. If an additional layer is present, the additional layer may also be an absorbent layer. Alternatively, the additional layer may be a layer which protects the absorbent layer from damage, but allows the cleaning fluid being absorbed to pass through the outer layer of the absorbent layer. This type of layer is often referred to as a liquid transfer layer.

The liquid transfer layer desirably comprises a highly porous material that readily allows and/or facilitates the transfer of liquids in and out of the cleaning sheet. Additionally, the liquid transfer layer also needs to be sufficiently durable and strong to withstand the rigors associated with hard surface cleaning. Desirably the liquid transfer layer has a minimum Grab Tensile of about 7 kg. Additionally, the liquid transfer layer desirably has a minimum abrasion resistance of at least 500 cycles (as measured by the Reciprocal Abrasion Test) and still more desirably has a minimum abrasion resistance of at least 1000 cycles. In addition, the liquid transfer layer desirably has a sufficient degree of openness to have a Frazier Porosity of at least about 200 cubic feet/square foot/minute. The liquid transfer layer desirably comprises a material having a basis weight below about 64 g/m^2 and still more desirably a material having a basis weight between about 15 g/m^2 and about 50 g/m^2. An exemplary material comprises spunbond fiber webs such as, for example, those described in US Patent No. 5,382,400 to Pike et al., US Patent No. 5,874,460 to Keck, US Patent No. 5,460,884 to Kobylivker et al., US Patent No. 5,858,515 to Stokes et al., US Patent No. 5,707,735 to Midkiff et al., and US Patent No. 6,200,669 to Marmon et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. The fibers can be round or have one or more various shapes such as for example, multilobal, wedge shaped, crescent shaped, ribbon shaped and so forth. In addition, perforated films and fabrics are also well suited for use as or in the liquid transfer layer. Exemplary perforated nonwoven

fabrics include, but are not limited to, those described in US Patent No. 5,858,504 to Fitting, US Patent No. 5,188,625 to Van Iten et al., US Patent No. 5,620,779 to Levy et al., US Patent No. 3,949,127 to Ostermeier et al. and US Patent No. 4,154,885 to Tecl et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. In addition, highly porous or open fabrics having varied or irregular surfaces, e.g. projections or undulations, are also believed suitable for use in the present invention. Exemplary materials of this type include, but not limited to, those described in US Patent No. 4,741,941 to Englebert et al., US Patent No. 4,970,104 to Radwanski and US Patent No. 5,643,653 to Griesbach et al.; the entire contents of each of the aforesaid references are incorporated herein by reference. Further, the liquid transfer layer can comprise an apertured film. Apertured films believed suitable for use with the present invention and methods of making the same are described in US Patent No. 4,280,978 to Danhiem et al., US Patent 5,370,764 to Alikhan and US Patent No. 5,262,107 to Hovis et al. In addition, the liquid distribution layer can comprise multilayer laminates of two or more of materials. As a particular example, the liquid distribution layer can comprise an apertured film/nonwoven web laminate. Desirably, the liquid transfer layer is a PUB spunbond material.

An additional layer may be present in the cleaning sheet. A liquid barrier layer may be positioned between the first layer and the second layer, to prevent the cleaning fluid being absorbed from getting into the first layer or the dry cleaning layer. Attention is directed to Figure 3, which shows cleaning sheet 101 having a barrier layer 130, position between the first layer 110 and the second layer 120

The barrier layer desirably comprises a material that substantially prevents the transmission of liquids under the pressures and chemical environments associated with surface cleaning applications. Desirably, the liquid barrier layer comprises a thin, monolithic film. The film desirably comprises a thermoplastic polymer such as, for example, polyolefins (e.g., polypropylene and polyethylene), polycondensates (e.g., polyamides, polyesters, polycarbonates, and polyarylates), polyols, polydienes, polyurethanes, polyethers, polyacrylates, polyacetals, polyimides, cellulose esters, polystyrenes, fluoropolymers and so forth. Desirably the film is hydrophobic. Additionally, the film desirably has a thickness less than about 2 mil and still more desirably between about 0.5 mil and about 1 mil. As a particular example, the liquid barrier layer can comprise an embossed, polyethylene film having a thickness of approximately 1 mil.

In addition, one or more of the polymeric components within the cleaning sheet can contain minor amounts of compatibilizing agents, colorants, pigments, optical brighteners, opacifying agents, ultraviolet light stabilizers, antistatic agents, wetting

agents, additives for improving abrasion resistance, nucleating agents, fillers and/or other additives and processing aids. As an example, the liquid barrier layer can contain opacifying agents, e.g. TiO_2, in order to provide a white, substantially opaque film.

The layers of the cleaning sheet are bonded together using any suitable means, such as adhesive bonding, thermal bonding, ultrasonic bonding, mechanical stitching and the like. Desirably, thermal bonding is used.

As indicated herein above, the cleaning sheets of the present invention are well suited for use with a variety of cleaning equipment and, more particularly, are readily capable of being releasably-attached to the head of a cleaning tool. As used herein, "releasably-attached" or "releasably-engaged" means that the sheet can be readily affixed to and thereafter readily removed from the cleaning tool. In reference to FIG. 4, cleaning tool 240 can comprise handle 248, head 244 and fasteners 246. Cleaning sheet 243 can be superposed with and placed against head 244. Flaps 247 can then be wrapped around head 244 and releasably-attached to head 244 by fasteners 246, e.g. clamps. With cleaning sheet 243 affixed to head 244, cleaning tool 240 can then be used. As examples, the size and/or shape of the handle can vary, the head can be fixed or moveable (e.g. pivotable) with relation to the handle, the shape and/or size of the head can vary, etc. Further, the composition of the head can itself vary, as but one example the head can comprise a rigid structure with or without additional padding. In another configuration, the one of the layers of the cleaning sheet may extend pass the cleaning surface, thereby forming wings flaps 247. These wing or flaps may have different shapes and may be used to attach the cleaning sheet using a suitable means described above. Further, the mechanism(s) for attaching the cleaning sheet can vary and exemplary means of attachment include, but are not limited to, hook and loop type fasteners (e.g. VELCRO fasteners), clamps, snaps, buttons, flaps, cinches, low tack adhesives and so forth.

In using the cleaning sheet of the present invention, the surface to be cleaned is first wiped with the first side, the dry cleaning side. The will cause the dust, dirt or other loose debris to be trapped into the dry cleaning portion of the cleaning sheet. Once the surface is wiped with the dry cleaning portion of the cleaning sheet, the cleaning sheet is then turned over and the absorbing side of the cleaning sheet is used to absorb and cleaning fluid applied to the surface to be cleaned, thereby removing any dirt or stains physically attached to the surface to be cleaned.

Examples

Various wipe concepts of the present invention were prepared. A 1 ounce per square yard ((osy), 33.9 grams per square meter, (gsm)) prepared in accordance with U.S. Patent 5,858,515 to Stokes was unwound onto a forming wire. Applied to this spunbond material is coform having a mixture of about 50 % by weight pulp and 50% weight polypropylene, prepared in accordance with U.S. Patent 4,100,324 to Anderson. The layers were thermally bonded together and the resulting cleaning sheet had a basis weight of about 250 gsm (7.4 osy).

A high loft spunbond, having a basis weight of 61 gsm (1.8 osy) prepared in accordance with U.S. Patent 5,382,400 to Pike was unwound and place onto a forming wire. On to the high loft spunbond, a first layer of coform having a mixture of about 70 % by weight pulp and 30% weight polypropylene, prepared in accordance with U.S. Patent 4,100,324 to Anderson was placed. On the first layer of coform a second layer of coform was deposited having a mixture of about 50 % by weight pulp and 50% weight polypropylene, prepared in accordance with U.S. Patent 4,100,324 to Anderson. The layers were thermally bonded together and the cleaning sheet had a basis weight of about 310 gsm (9.1 osy).

A high loft spunbond, having a basis weight of 61 gsm (1.8 osy) prepared in accordance with U.S. Patent 5,382,400 to Pike was unwound and place onto a forming wire. On to the high loft spunbond, a first layer of coform having a mixture of about 70 % by weight pulp and 30% weight polypropylene, prepared in accordance with U.S. Patent 4,100,324 to Anderson was placed. On the first layer of coform a second layer of coform was deposited having a mixture of about 40 % by weight pulp and 60% weight polypropylene, prepared in accordance with U.S. Patent 4,100,324 to Anderson. The layers were thermally bonded together and the cleaning sheet had a basis weight of about 161 gsm (4.7 osy).

Each cleaning sheet was used to clean a surface by first using the spunbond side of the cleaning sheet to remove particles and the reverse side of the sheet was used to absorb cleaning fluid used to clean the surface after the particles were removed. Each cleaning sheet exhibited good properties for dry cleaning and absorbing a cleaning fluid and dirt. In addition, the PUB layer in the first sample provided a loop means to attach the cleaning sheet to an implement having hooks.

While the embodiments of the invention described herein are presently preferred, various modifications and improvements can be made without departing from the spirit and scope of the invention. The scope of the invention is indicated in the appended claims, and all changes that fall within the meaning and range of equivalents are intended to be embraced therein.